

# Relevance of the Concept of Garden in Medieval Islamic Andalusia to Contemporary Discourse on Climate Change

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## Abstract

Contemporary discourse on climate change lays emphasis on reduction of greenhouse gases and plantation of more trees to expand the green cover. Almost similar type of emphasis was stressed upon by the Muslim rulers of medieval Islamic Andalusia, who while building large palaces also laid stress on creating gardens and landscapes where fruit-bearing trees, variety of flowers and plants of different species were planted. The notion of garden was inspired by Quranic teachings and the quadripartite pattern of gardens developed by the Umayyad rulers was emulated by their successors. The scientific management of gardens by the medieval rulers of Islamic Andalusia bears relevance in the contemporary discourse on climate change and is worth emulating to enhance resilience against the vagaries of climate change.

**Keywords:** climate change, gardens, Alhambra, Umayyads, Granada, Sects Era

## 1. Introduction

**I- Subject of the Study:** Relevance of the concept of Garden in Medieval Islamic Andalusia to Contemporary Discourse on Climate Change

### II- Problem:

To analyze the concept of garden in the medieval Islamic Andalusia

### III- Limitations:

This analysis is limited to historical development of gardens in the Medieval Andalusia under different Islamic rulers. Allusions to other notions like climate change and palace complexes and landscape are referred to augment comparative and historical analysis.

### IV- Theoretical Framework:

It is a historical topic and no theoretical framework has been developed. However, significance of gardens in alleviating hazardous impact of climate change finds very brief theoretical framework

### V- Methodology:

Major tools of research – historical, analytical, comparative and descriptive – have been applied. More emphasis is focused on historical technique. Relevant material available in English, Arabic and Spanish languages has been used and Arabic sources are used in translated (into English) form

### VI- Previous Researches etc.:

Undoubtedly, some work in the form of academic research has been undertaken in the realm of gardens in Medieval Andalusia in recent years; nevertheless, the research studies available seldom focus on the contemporary discourse on climate change vis-à-vis relevance of the medieval Andalusian notion of garden in alleviating the adverse impact climate change.

### VII- Results and Conclusion:

This brief study makes it discernible that at a time when almost the entire humankind is adversely impacted upon by the vagaries of climate change and increasing ecological disequilibrium, the focus on expanding green cover via proliferation of gardens and landscapes by the Muslim rulers of Islamic Andalusia provides an easy and workable solution in mitigating the adverse impact of climate change.

### VIII- Bibliography:

The books and other materials used in the study are shown in the references.

### XI- Outline of the Study:

1. Introduction
2. Gardens and Climate Change
3. Gardens under the Umayyad Rule
4. Gardens under the Kings of Sects Era
5. Gardens under the Nasrid-ruled Granada
6. Conclusion
7. References

## 2. Introduction

In common parlance, gardens are construed as a tract of land where different species of plants, including trees, flowers and other species of plants, are grown. Construction of gardens commence as secular efforts, emanating

from the practical need “to organize the surrounding space, tame nature, enhance the earth’s yield and create a legible map on which to distribute natural resources” (Ruggles, 2008: ix).

The Muslim conception of garden is greatly influenced by recurring references to the conception of Paradise, the ideal garden, in the Quran, which *inter alia* paints “so detailed a picture of the state (of blessedness) reserved exclusively for Believers that it might have served as a model for the creators of gardens in both East and West” (Marcias, 1986: 1345), (Ibn Manzur, 1987, 2:190). There are frequent references in the Quran to gardens and the term ‘garden’ is used as a conceivable analogue for the life in Paradise that is promised to Believers: “Allah has promised to the believing men and the believing women gardens, beneath which rivers flow, to abide in them, and goodly dwellings in gardens of perpetual abode; and best of all is Allah's goodly pleasure; that is the grand achievement (al-Qur'an 9.72), (Ibn Manzur, 1987: 190).

Envisioned as a paradise in Muslim thought, the conception of garden gets fairly detailed description in Quran as is evident from this verse: “The semblance of Paradise [janna] promised the pious and devout (is that of a garden) with streams of water that will not go rank, and rivers of milk whose taste will not undergo a change, and rivers of wine delectable to drinkers, and streams of purified honey, and fruits of every kind in them, and forgiveness from their Lord” (al-Quran: 47:15).

Allusions to garden are found in other Quranic verses: gardens and springs (al-Quran: 44:52), an endless variety of fresh fruit suspended within easy reach (al-Quran: 44:55 and 55:54), garments of brocade and silk (al-Quran: 44:53), carpets (al-Quran :55:54), and companions with large dark eyes (al-Quran: 44:54). Another Quranic verse explains two gardens with shady boughs traversed by flowing springs, as well as two other gardens with dark green foliage, fruits such as dates and pomegranates, and two gushing fountains (al-Quran: 55:46–68).

### 3. Gardens and Climate Change

Garden being a tract of land endowed with different species of plants, including trees, plays crucial role in the processes of mitigation and adaptation to the vagaries of climate change. Scientists have come to believe that plants entail the potential of altering the temperature of the Earth’s atmosphere in multiple ways. With the help of photosynthesis process, plants use energy from the sun to draw down carbon dioxide, the major cause of greenhouse gases; thereby, removing the carbon dioxide from the atmosphere (NASA, n.d.). Through the process of transpiration, plants also cool the atmosphere by releasing excess water into the air from their leaves; thereby, causing more precipitation and cloud formation culminating in cooling the atmosphere. Owing to these processes, scientists believe the potential of plants in having a sizeable impact on global climate in the future (NASA, n.d.), (Hamed, 1994: 2)

Environmental scientists treat garden and landscape as interactive systems. The ruling Muslim elite in Islamic Andalusia are reported to have taken environmental factors into account while getting gardens constructed. “This approach may seem entirely utilitarian and blindly ahistorical, but many environmental scientists are in fact deeply concerned about the preservation of historic landscape systems that were ecologically balanced and aesthetically pleasing (Ruggles, 2008: 5), (Hamed, 1994:1)

### 4. Gardens Under the Umayyad Rule

Advent of Umayyad rule in Andalusia in early eighth century, especially under the reign of Abd al-Rahman I, there began a process of development of long line of gardens and garden estates in Cordova and in its vicinity and founding of al-Rusafa on the pattern of its namesake in Syria in the middle of the eighth century marked the beginning of this process. The development of garden estates witnessed blending of agricultural enterprise with the cultivation of nature ‘for the sake of beauty’ and this combination proliferated throughout the ninth and tenth centuries and the Umayyad regime in Andalusia reaped good dividends (Al-Himiari, 1988: 78).

Development of garden estates proved instrumental in making agriculture as the backbone of Andalusian economy and this “set off a cyclical process in which agricultural surpluses led to flourishing urban markets, which encouraged capital investment, in the countryside, where farms were located, which in turn contributed to greater yields. The two factors of agricultural transformation and economic development reverberated within the medieval consciousness of the landscape’s potential for economic yield and inhabitability, with tremendous ramifications for the design of landscapes and gardens” (Ruggles, 1992: 163), (Ibn Al-Awwam, 1802: 147).

There developed a language of landscape that entailed a code for a system of social, political and economic values placed on land and these values were articulated by a set of visually organized objectives intended for the caliph and his court of Umayyad rule over Andalusia. Articulation of this code was facilitated through artistic expression in the highly artificial environment of palace gardens. Water, being the conceptual underpinning of garden, was transported and distributed through decorative channels and raised or sunken flower beds. Most of the gardens had geometric layouts. “The art of creating a superb garden symbolized the appropriation of the kingdom’s territories and referred to the leadership required to implement a hydraulic system capable of literally supporting a royal garden and, conceptual extension, an entire agricultural landscape (Ruggles: 1992:163), (Ibn Al-Awwam,

1802: 152).

The Umayyad gardens were characterized by mutual interaction between the garden and environment. On the one hand, environment impacted upon the gardens and garden estates because these estates were shaped by the agricultural techniques, plant species, soil, water and climate; and, on the other hand, the gardens also wielded impact upon the environment via its plant species which facilitated photosynthesis process and releasing water vapours in the atmosphere. According to Watson (1983), augmentation in available cultivars and botanical knowledge accumulated during the first two centuries of Umayyad rule in Andalusia was facilitated by royal patronage and gardens, which were repositories of exotic plant species and testing ground for new techniques that in turn stimulated agricultural expansion into hitherto un-arable areas.

The palace of al-Rusafa, built three kilometers northwest of Cordova during first Umayyad ruler Abd al-Rahman I's regime (756-788), was the first garden state in Islamic Andalusia where transplantation of exotic plants from far and wide took place. While lavishing praise on the beautiful irrigated gardens of al-Rusafa, historian Al-Maqqari said: "Abd al-Rahman had sent messengers to foreign parts to obtain special plants so that al-Rusafa become famous for the excellence of its plant varieties" (Al-Maqqari, 1967, vol.1: 304), (Al-Himiari, 1, 1988:78). When the seeds of pomegranate brought from Syria ripened into fruition in al-Rusafa, the then Umayyad ruler got pomegranate planted in his other gardens and the people planted pomegranate species in groves of them (Al-Maqqari, 1967, vol.1: 305), (Al-Himiari, 1988:467).

This is alluded to as a first reference to a botanical garden in Islamic Andalusia where exotic plants could be transplanted successfully and acclimatized. According to one opinion, it not only demonstrated keen interest in botany and practical agronomy that prevailed in the eighth century Andalusia, but also makes it discernible that as to how royal patronage promoted the spread of improved plant species (Samsó, 1981-82: 138-139; Watson, 1983: 89).

Under the Umayyad rule, proliferation of garden culture continued and its important expression was realized in the palace city of Madinat Al-Zahra, located in the vicinity of Cordova, which carried forward the Cordovan tradition of building farm and recreation estates in the agricultural (Al-Himiari, 1988:95).

Zone surrounding the city; the architectural type adopted in Madinat Al-Zahra was seemingly new to Umayyad ruled Andalusia. While following the pattern of al-Rusafa, Madinat Al-Zahra was built on a pattern, different from Cordova, where the landscape was made green and fertile through the introduction of water from the mountains for irrigation and through planting of gardens and orchards both for enjoyment and profits (Ruggles, 1992: 164), (Al-Himiari, 1975:80-82).

The gardens of Madinat al-Zahra were divided into unequal quadrants by walkways. The palace was equipped with pavilions and pools and some of these pools stocked fish for human consumption. From either pavilion side, a spectator could see the reflection of the other in the shimmering surface of the pool and this spectacle of the architectural effect look both illusionistic and entirely real (Ruggles, 2008: 46), (Al-Himiari, 1975:95).

Located in the foothills of Sierra Morena and built in a series of stepped levels cut into the southern slope of a mountain, Madinat al-Zahra afforded views onto the palace gardens and from these gardens toward the landscape beyond. Archeological remains of only three gardens at al-Zahra have been discovered and these inter alia include: Prince's garden, the Upper Garden and the Lower Garden. The Prince's Garden was a small elegant residence that perhaps served as private dwelling unit for the privileged members of the royal family. From the archeological remains, it is also revealed that there is a paved walkway bordered by water channels, which forms a longitudinal axis dividing the garden into two almost equal parts (Barrucand & Bednorz, 2002; Creswell, 1958), (Ibn el-Kardabous, 1971:58). Madinat al-Zahra served as the model for subsequent palace estates built in Cordova until the overthrow of the Umayyad rule in the early part of the eleventh century.

The spell of the Umayyads rule also witnessed development of garden design into a fixed set of forms, in which water had emerged as one of the principal signifiers in garden symbolism. Water was clearly displayed by the Umayyads in large fountains, handsome bathhouses, and of course the gardens themselves, where flowers and foliage were a visible sign of the nurturing capacity of water (Ruggles, 2008: 26).

In the aftermath of the fall of Umayyad rule in Andalusia, when the Andalusian poet Ibn Zaydun visited Cordova and stayed at Madinat al-Zahra. While making a comparative assessment of Madinat al-Zahra of Umayyad days and the Madinat al-Zahra of post-Umayyad period, Ibn Zaydun wrote: "The flower gardens smiled with their silvery waters, like collars loosened from the necks of fair maidens... Now I enjoy the view of flowers to which my eyes are attracted, and dew weighs heavily on them—their stems are drooping" (Cited in Ruggles, 2001: 136-37)

When the Andalusian poet Ibn Zaydun returned to Cordoba after a bitter civil war and an absence of many years, he camped in the halls of the abandoned caliphal city, Madinat al-Zahra', and recalled an old love affair. He compared the flourishing landscape of earlier days when "the flower gardens smiled with their silvery waters, like collars" with the devastation and sadness of the present: "12 The garden represented the trace of something gone and irretrievable, a love and an era that had slipped away, but that was recalled in the poet's return to the place

(Ibn Sahib al-Salah, 1965: 188).

The quadripartite plan of gardens, developed in Islamic Andalusia as legacy of the Umayyad dynasty, subsequently emerged as an influential symbol of sovereignty in the Maghreb as well as elsewhere in the Islamic world and this legacy proved “so enduring and influential that it was embraced by subsequent Muslim dynasties in Morocco and Spain” (Ruggles, 2008: 47)

### 5. Gardens under the Kings of Sects Era

In the aftermath of the fall of Umayyad rule in Islamic Andalusia, there emerged the period of *muluk al-Tawa'ef*, or independent kingdoms. The idea of garden was disseminated to the capital cities and royal palaces of the Sects “*Al-Tawa'ef*” kingdoms in other parts of Spain. Kingdom of Seville, the largest and most powerful of these kingdoms, had a palace zone that straggled on either side of the city wall, as well as a number of suburban palaces. In the eleventh century, the then ruler of Seville, al-Mutamid (1069-1091), ordered the planting of the area of Seville called the Buhayra, now called Hureta der Rey. He placed a pavilion at the centre of the Buhayra's orchards and gardens, so that their productive aspect was comingled with the enjoyment of their aesthetic qualities (Ibn Sahib al-Salah, 1965a: 464-465), (Ibn Khaldun, 4, 1958: 203).

Undoubtedly, the task of reconstruction undertaken during the Almohad period culminated in the destruction of the most of the original fabric of al-Mutamid's al-Mubarak Palace, which stood within the city walls; nonetheless, some idea of gardens could be discerned from verses that lavished praise on the different varieties of colourful flowers like roses, lilies, jasmine, stock, violets, poppies and other flowers that “attract gaze and make the eyes dally with delicate buildings that seem like spider webs” (Quoted in Ruggles, 1992: 167).

Archeological excavations in the Seville Alcazar have revealed the discovery of three quadripartite gardens. It is further discerned that the garden adjacent to the west side of the former Islamic palace had four quadrants that were deeply sunken and irrigated by water distributed in canals flowing along the walkways. It also becomes discernible from the excavations that jasmine and orange trees were planted in the beds. Results of some excavations have not been published and Ruggles has quoted these in his book: “At one end of the garden there are vestiges of an even older eleventh-century garden with sunken pools. Elsewhere in the same palace complex another twelfth-century garden, known as El Crucero, had four quadrants sunken to an extraordinary depth of five meters, also planted with orange trees, the topmost branches of which were level with the surrounding walkway” (Ruggles, 2008: 46), (Salem, 1958:78).

In 1171, the Almohad ruler Abu Yakub Yusuf added a magnificent group of palaces to Buhayra, supplying them with water via a renovated Roman *qanat* (underground aqueduct) (Ibn Sahib al-Salah, 1965: 468-69). According to Ibn Sahib al-Salah, in the twelfth century, the then caliph commanded his officials to design for him everything pertaining to his palace construction. He also ordered to utilize the barren land surrounding the palace by planting olive trees, fig trees, vineyards and fruit trees of rare and delicious fruits: “The caliph used to ride out from his palace in Seville with his principal followers for the enjoyment of watching the olives being planted. Ahmad Ibn Basu, the foremost architect in al-Andalus, had no equal in his work on these palaces in Buhayra” (Ibn Sahib al-Salah, 1965b: 464-66).

### 6. Gardens under the Nasrid-ruled Granada

The medieval Islamic Granada, like Cordova and Seville, was situated in a fertile landscape irrigated by streams and rivers that provided abundant water for its palace and agricultural estates. According to the historian Ibn al Khatib, the Alhambra and the Granada itself, was densely planted with so many verdant gardens that ‘the light-coloured stone of the palaces’ many tall towers shone like bright stars in an evening sky of dark vegetation’ (Simonet, 1872:47), (Ibnel Khateeb, 1, 1955:91,97).

The Alhambra Palace was built by the Nasrid rulers of Granada during the thirteenth and fourteenth centuries. A cross-axial garden adorns the Court of the Loins and it consists of four sunken garden beds surrounded and crisscrossed by paved paths. Intersection at the paths in the centre of the garden entails an elegant basin which is held aloft on the backs of twelve stone-loins. Water runs toward the Loins Fountain. The garden centre serves as the meeting place of axial currents and facilitates pouring of water from the mouths of the loins (Ruggles, 2008: 49), (Salem, 1958:144-145).

A garden predating the Court of Loins existed in the Generallife Palace. Acequia Court located within the Generallife Palace runs down its centre axis and it is almost four times as long as it is wide. The presence of a narrow walkway across the centre creates a *chaharbagh* (quadripartite garden) like the Court of Loins. Citing archeological evidence; Ruggles (2008: 49) points out that the quadrants were sunken seventy centimeters below the level of the pavements and were perhaps planted with a low carpet of vegetation with some big shrubs.

The cross-axial garden had emerged as a potent symbol of territory, possession and the sovereign rule under the Umayyad regime in Islamic Andalusia. While asserting that the palatine garden served as a metaphor, not only for the organization of the landscape, but also the political economy, Ruggles (2008: 49) writes that the sovereign sat in a central location, either in the middle of the garden or overlooking its primary axis, and looked across the

meticulously gardened space. The Nasrid rulers built palace complexes adorned with multiple gardens.

For Nasrid rulers, to some extent garden-making had become an automatic gesture, writes Ruggles (2008: 49): “But in another sense, the generous proportions of the Generalife’s Acequia Court, and the four-part layout of the Alhambra’s garden in which growling lions guard the fountain, the symbolic source of water, continued to have a powerful meaning as a metaphor for the organization and possession of the land.”

Hillenbrand (1982: 170) opines that gardens in Alhambra complex are far more extensive than its buildings. According to him: “Along the length of principal garden runs a canal flanked by a series of fountains who’s quite splashing adds the dimension of pleasurable sound to the visual opulence of the garden. Shaded parterres, clipped hedges, pavilions, reflecting pools, sunken flower beds and a network of intersecting alleys are enclosed by a wall. Together these elements create the sense of a jeweled private world removed from the pressures of daily life a true *hortus conclusus* and thus an image of paradise” Hillenbrand (1982: 170), (Salem, 1958:148-149).

## 7. Conclusion

Contemporary discourse on climate change emphasizes on reduction in emission of greenhouse gases by expanding the green cover of planting more trees to maintain environmental equilibrium. The ruling elite of Islamic Andalusia, though not conversant with current nuances of climate change like mitigation and adaptation, yet they emphasized on the expansion of green cover through landscapes and gardens where plant species of different varieties were grown. Transplantation of different varieties of trees and flowers not only helped in maintaining environmental equilibrium, but also helped in ensuring food security. Since agriculture constituted the spine of Islamic Andalusian economy during the Umayyad rule, Sects “*Al-Tawa’ef*” kingdoms and under the Nasrid rule in Granada, management of water and soil resources were also accorded priority. In other words, management of the gardens in the Islamic Andalusia was a forerunner of contemporary environmental management in a sustainable manner and hence it has come to assume relevance in the contemporary discourse on climate change.

## References

- Al-Qur’an. Trans Ahmed Ali. Princeton: Princeton University Press, 1988.
- Al-Himiari, Abu Abdullah Mohammad Bin Abdullah Bin Abdul Muni’m, *Al-Raud el-Mi’tar Fi Khabar el-Aqtar*, investigated by: Ishaan Abbas, Beirut Press, Beirut, 1975.
- Al-Himiari, Abu Abdullah Mohammad Bin Abdullah Bin Abdul Muni’m, *Sefat Jazerat Al-Andalouse*, “Description of the Island of Andalusia”, (selected from the book of : *Al-Raud el-Mi’tar Fi Khabar el-Aqtar*), Levi Provençal investigated its publication, correction and its footnotes; Dar el-Jeel, 2<sup>nd</sup> edition, Beirut, 1408 H/ 1988 AD.
- Al-Maqqari, Ahmed Ibn Mohammed (1967), in R. Dozy et al., *Analectes sur la Histoire et la Litterature des arabes d’Espagneed* (Analects on the history and Literature of the Arabs of Spain), Reprint, Amsterdam. 2 Vols.
- Barrucand, Marianne & Bednorz, Achim (2002), *Moorish Architecture in Andalusia*, Taschen.
- Creswell, K.A.C. (1958), *A Short Account of Early Muslim Architecture*, London: Penguin Books, Hamed, Safei El-Deen, Paradise on earth: Historical gardens of the arid Middle East, Lands Newsletter, ( Desert Architecture III: Building A Sustainable Future), No 36, 1994.
- Hillenbrand Robert (1982), “Alhambra”, in Joseph R. Strayer ed. *Dictionary of the Middle Ages*, Vol. 1, New York: Charles Scribner’s Sons,
- Ibn Al-Awwam, Abu Zakaria “Yahya Ibn Mohammad Ibn Ahmad Ibn Al-Awwam Al-Ishbilil, “Kitab Al-Filaha”: Book on Agriculture, Madrid, 1802.
- Ibn El-Kardabous, Abu Marwan Abdul Malik Bin el-Kardabous, *History of Andalusia*, edited by: Dr. Ahmad Mukhtar Al-A’bbadi, Islamic Studies institute, Madrid, 1971.
- Ibn Khaldun, Abdul Rahman Bin Mohammad Al- Maghrebi, *Kitab el-I’ber wa diwanel Mubtada Wal Khabar Fi Ayyamel Arab Wala’jam Wal-Berber waman Aasarahum min Thawi Al-Sultanel Akbar*, 1 ed, Vol. 4, Darel, Kitabl Al-Lubnani liltibaa’ Wal Nashir, Beirut: 1958.
- Ibnel Khateeb, Lisan Eddin Abu Abdullah Mohammad Al-Telmasani, *Al-Ihata fi Akhabar Ghirnata*, edited and introduced by: Mohammad Abdullah A’nan, Dar Al-Maarif in Egypt, pt. 1, Cairo: 1955.
- Ibn Manzur, Muhammad ibn Mukarram ibn `Ali ibn Ahmad ibn Manzūr al-Ansari al-Ifriqi al-Misri al-Khazraji Jamal al-Din Abu al-Fad, Lisan al-‘Arab (The tongue of the Arabs), Part 2, Sader Press House, Beirut, 1984.
- Ibn Sahib al-Salah, 1965a, p. 188, cited in Bosch-Villa, Jacinto (1984), *Historia de Sevilla: la Sevilla Islamica*, (History of Seville: the Islamic Seville) 712-1248, Seville: University of Seville Press, 273-283, Translated version.
- Ibn Sahib al-Salah, 1965b, pp. 464-66, reproduced in Rubiera, Maria Jesus (1988), *La arquitectura en la literatura arabe: datos para una estetica del placer* (Architecture in Arabic literature: data for an aesthetic of pleasure), Madrid. Translated version.
- Marcais, G. (1986), “Bustan”, in B. Lewis, Ch. Pellat & J. Schacht (eds.), *Encyclopedia of Islam*, Vol. 1, Leiden:

- E.J. Brill.
- NASA (n.d.) (National Aeronautics and Space Administration), "How Plants Can Change Our Climate", available at: <https://earthobservatory.nasa.gov/Features/LAI/LA12.php>.
- Ruggles, D. Fairchild (1992), in Jerrylynn D. Dodds (ed.), *Al-Andalus: The Art of Islamic Spain*, New York: The Metropolitan Museum of Art.
- Ruggles, D. Fairchild (2008), *Islamic Gardens and Landscapes*, Philadelphia: University of Pennsylvania Press.
- Ruggles, D. Fairchild (2001), *Gardens, Landscape, and Vision in the Palaces of Islamic Spain* University Park: Pennsylvania State University Press
- Salem, Assayed Abdul Aziz, *Al-Masajed wa Al-Qousor fi Al-Andalouse*, "Masajed and Palaces in Andalousia", Egraa` Journal, No. 190, Cairo- United Arab Republic, 1958.
- Samso, Julio (1981-82), "Ibn Hisam al-Lajmi y el primer jardin botansco en al-Andalus" (Ibn Hisham al-Lajmi and the first Botanical garden in al-Andalus), *Revista del Instituto Egipcio de Estudios Islamicos en Madrid*, 21
- Simonet, Francisco J. (1872), *Descripcion del Reino de Granada sacada de los autores arabigos*, (Description of the Kingdom of Granada taken from the Arabic authors,), 711-1492, Amsterdam.
- Watson, Andrew M. (1983), *Agricultural Innovation in the Early Islamic World: The Diffusion of Crops and Farming Techniques, 700-1100*, Cambridge: Cambridge University Press.